

Prosodic Structure in SiSwati*

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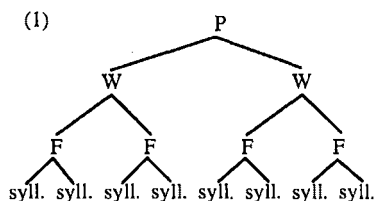
1. Introduction

There are several phonological patterns in SiSwati, a member of the Nguni sub-family of the Bantu family of languages, which point to the existence of some sort of prosodic structure. This paper will describe those patterns and compare and contrast the prosodic structure of SiSwati with the types of prosodic structures which occur cross-linguistically.

One theory which has tried to describe prosodic structure cross-linguistically is metrical phonology. One of the insights of metrical phonology is that words are not just strings of sequential elements but rather that they are organized hierarchically into rhythmic units. Instead of rhythm being represented featurally, it is represented structurally as an organization of syllables, words, and phrases. This conception of structure is developed by, for example, Liberman and Prince (1977) and Selkirk (1980).

One of the ways in which this organization has been represented is in prosodic phonology, where a constituent tree hierarchy is proposed to express the metrical structure of a language (Nespor and Vogel, 1986). The hierarchy is strictly layered, with each constituent of a lower level being dominated by a constituent at the next level up, although later work indicates that strict layering may not be a necessary component of the hierarchy, and that elements undominated by constituents at the next higher level may still be prosodically licensed (Downing, 1993, Bagemihl, 1991). In this hierarchy, syllables are gathered into binary feet, feet are gathered into words, and words are gathered into phonological phrases. Such groupings apply to all syllables, regardless of morphological or syntactic structure.

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This paper will concentrate on structure at the level of the foot, that is, the structure immediately dominating syllables, since that is the level that is of interest in SiSwati. Feet have a different status in different languages. In English, for example, feet are so important that children often cannot even pronounce material outside of the foot, such as an unstressed initial syllable. Thus, English-acquiring children often say things like [nænə] for "banana," omitting the unstressed initial syllable which is not part of the foot. Gerken (1996) surveys work pointing to canonical metrical patterns in children's early speech, citing as supporting evidence facts such as the more frequent omission of weak syllables from the sequence weak-strong (like in the word "giraffe") than from the sequence strong-weak (like in the word "zebra"). Echols (1996) also discusses the "trochaic bias" of young English-acquiring children, who tend to focus on, store, and then produce strong-weak sequences. Of course, this trochaic bias is later weakened, as evidenced by the fact that adults can produce a greater range of structures than just strong-weak, although Cutler (1990) does report that the most common word type in English is a polysyllable with initial stress. The foot in English is also crucial in phonological processing, as shown by Cutler and Norris (1988). They showed that in English, strong syllables (with full vowels) are likely lexical word onsets and so listeners attempt lexical access at strong syllables.

In Indonesian, the evidence for foot structure is stress assignment, which does seem to pervade the language, just as it does in English (Cohn and McCarthy, 1994). However, contrary to the situation in English where foot-structure is only marginally affected by morphology (as in, for example, tri-syllabic laxing), foot structure in Indonesian is greatly influenced by morphology. Suffixed words act differently in stress assignment than non-suffixed words. For example, suffixed words do not have the secondary stress that is present in monomorphemic words of the same length. This can be seen in a comparison of the four-syllable suffixed form [bicará-kan] "speak about" with the four-syllable monomorphemic form [bijaksána] "wise." This difference in stress between suffixed and unsuffixed forms corresponds, Cohn and McCarthy suggest, "to the traditional distinction between rhythmic and demarcative stress." Thus, in Indonesian foot structure is present throughout the language and interacts with the morphology.

In Japanese, on the other hand, foot-structure is not so all-pervasive as it is in English and in Indonesian. However, the foot, or at least some notion of binarity of morae or syllables, is still a useful construct in a description of Japanese. For example, truncations obey minimality restrictions, both for minimal word size (greater than a syllable) and for minimal stem size (at least bimoraic) (Itô, 1990). An example is that [saiko], a name, can be shortened to the bimoraic [sai-chaN], since the name is a stem which must be followed by the suffix [chaN] whereas [saikederikku], "psychedelic," a borrowing, can only be shortened to bisyllabic [saikε], since it is a free-standing word.

Even in languages in which feet have not been posited before, such as in Sesotho, a Southern Bantu language which has "stress" as a prominence on the penult, early words are typically bisyllabic (Demuth, 1996, reporting on work by Connelly, 1984). However, only examples where a bisyllabic root is left after the prefix is truncated are reported. No examples of truncations of trisyllabic or longer roots are reported. Thus it is not clear

whether this phenomenon is evidence for a bisyllabic template or for omission of inflectional morphology. Supporting evidence for a bisyllabic template in Sesotho comes from bisyllabic word minimality, which is a restriction in the language.

Thus, even in languages without stress-based alternating rhythmic feet there is still evidence from minimality and from acquisition for some kind of "foot." Foot-structure thus differs in both functional load and in function from language to language. Foot structure can serve either as a unit organizing syllables into strong and weak (which is the motivation for Hayes' (1995) metrical grid theory), as a template arranging syllables/morae into pairs (as seen by the use of "the foot" as a template in reduplication), or as a marker of prosodic edges (as, for example, with aspiration of voiceless stops in English).

In SiSwati, the prosodic structure is such that it is not clear whether the bisyllabic prosodic constituents that are present qualify as "feet" in the rhythmic, binary, strictly layered sense of the term. Nonetheless, evidence for bisyllabic prosodic constituents does appear throughout the language in different morphological domains (which are divisions of morphemes and strings of morphemes into classes based on function and distribution). However, there is evidence for only one such unit per morphological word, and in some cases the unit seems to be acting simply as a measure of bisyllabic minimality. Various types of evidence can be adduced for the presence of prosodic structure. One type of evidence for these prosodic constituents is the presence of additional material (in addition to the usual morphology) in a shorter word that is not present in a longer word. This extra material is not morphologically part of the word in that it would not be part of the lexical entry for either the root or the affix. Additional evidence for these prosodic constituents comes from alternations involving the edges of the constituents.

The constituents can be shown to be prosodic (and not morphological) due to the behavior of onsetless initial syllables. There is evidence that onsetless initial vowels, which are syllabified with the prefix, are excluded from the prosodic structure. Initial onsetless vowels cross-linguistically behave differently than vowels in syllables with onsets, as shown, for example, by a detailed examination of onsetless vowels in Kikereve (Odden, 1995).

It will be claimed here that the prosodic structure in SiSwati is not generalized so as to be "built" automatically on every word in the language. Rather, this type of structure will be assumed to be present only when there is direct evidence from augmentation or from alternations that attests to its presence. It is not assumed that the native speaker generalizes from the evidence and goes on to proliferate prosodic structure in other environments, but rather that the speaker/hearer tolerates ambiguity as to the presence or absence of prosodic structure, given a lack of positive evidence. As Trubetzkoy (1969, p.274) says, regarding phonological means of signaling sentence, word, or morpheme boundaries:

They can probably be compared to traffic signals in the street. ... It is possible to get along without them: one need only be more careful and attentive. Therefore they are not found on every street corner but only on some. Similarly, linguistic delimitative elements generally do not occur in all positions concerned but are found only now and then.

Furthermore, it is not assumed that syllables must be gathered into this type of prosodic structure to be pronounceable. This is contrary to what has been suggested for foot structure by the strict layering hypothesis (articulated by Selkirk, 1984). The conception of prosody in which units such as syllables or morae may be prosodic licensors without being dominated by higher level structure such as the foot resembles the prosodic structures described for Aranda by Downing (1993) and for Bella Coola by Bagemihl (1991), who allow for a mora to be a prosodic licensor without being syllabified. So too

syllables in SiSwati need not be parsed into these prosodic domains in order to be pronounced. Thus, $[\sigma \sigma]w$ is as permissible as $[[\sigma \sigma]F]w$.

Since, as discussed above, the notion of "foot" means so many different things in so many different languages, instead of taking "the foot" as a primitive constituent that is a part of a universal prosodic hierarchy, the "foot" will be decomposed into two more primitive concepts, the concept of binarity and the concept of a domain. The bisyllabic prosodic domain in SiSwati can then be viewed as the product of the general notion of binarity (Itô, Kitagawa, and Mester, 1995) applied to the general notion of phonological domains (Kisseberth, 1994). The general notion of binarity as described by Itô, Kitagawa, and Mester (1995, p. 25) states that:

In prosodic structures with no more than binary branching, every constituent lies at one edge (left or right) of some larger constituent, is prominent within some larger constituent. Constituent prominence in (maximally) binary structures can be expressed as alignment within a higher constituent. ... Every prosodic constituent is aligned with some (properly) containing prosodic constituent.

The general notion of "domains," as put forth by Kisseberth (1994, pp.133-134), is that they are: "a sequence of phonological material enclosed by a left and right bracket" which are "direct reflexes of phonological, morphological, and syntactic structure." Such domains are not restricted in size, and may be of any length. Selkirk (1986) is a precursor to Kisseberth in the use of prosodic domains, although it must be noted that she argues (contrary to the views taken here) that the theory of domains does not include feet, only higher levels such as prosodic words and prosodic phrases. She gives a representation of domains as follows:

(2) $a[...]a$ a = a syntactic or phonological category

The notion of general binarity captures a crucial pattern in language: a distinction or alternation between adjacent elements. There need to be distinctions created between adjacent elements in order for them to be both pronounceable and perceptible. One such example of an alternating pattern is syllable structure. For example, Mattingly (1981, p.418) writes that:

The general prerequisite for parallel transmission [which "makes possible higher information rates for speech than would be possible in a truly segmental process"] would appear to be that the constrictions of one or more closer articulations must be in the process of being released or applied in the presence of constrictions for one or more less close constrictions.

Another example of the pervasiveness of binarity for production and perception is the "Obligatory Contour Principle," originally motivated by tone languages, where adjacent identical elements are disfavored (Leben, 1973). A final example comes from stress, where rhythm is created by an alternation of strong and weak syllables (Hayes, 1995). Furthermore, binarity can be imposed on any level of structure, not just on the syllable (as it is in the traditional foot). For example, Stowell (1979, p.61) describes stress in Passamaquoddy, in which "feet themselves are paired into larger binary feet, resulting in an undulating stress contour from foot to foot."

Furthermore, the general notion of a prosodic "domain" is also useful, as has been shown by its utility in a wide range of issues. Many phenomena are neatly captured by prosodic domains. One example of a phenomenon that can be expressed using domains is tone and the issue of the span of realization of a tone (Odden, 1994; Kisseberth, 1995; Hsiao, 1995; Donnelly, 1996). Another such phenomenon is nasal harmony and issues

such as transparency and opacity (Homer, 1995). Yet another example involves vowel harmony and the issue of parasitic harmony (Cole and Kisseberth, 1994). One final example of the utility of domains is in accounting for vowel lengthening and issues such as the finding that vowel lengthening is greater when the voiced consonant is tautosyllabic with the preceding vowel (that is, in the same prosodic domain) than when they are heterosyllabic (Davis and Summers, 1989; Lauefer, 1992). Thus, the decomposition of "feet" into the concept of "binarity" applied to "domains" proves to be an insightful division to make, whereas taking "feet" as primitives does not allow for generalization to so many heterogeneous phenomena.

The first piece of evidence about prosodic structure in SiSwati comes from word minimality. The shortest word in SiSwati is two syllables long. Moreover, words which might otherwise be monosyllabic, because they consist of a single C root with a single vowel suffix, have an additional syllable added on which does not appear in words formed from longer roots. This is the first indication that there is some sort of prosodic structure present. The presence of the augmentative syllable in shorter forms indicates that in order to be pronounceable as a word in SiSwati, there must be at least two syllables. Instead of claiming that the presence of an augmentative syllable in what would otherwise be sub-minimal words implies that every word begins with a bisyllabic prosodic constituent, the minimality requirement will be interpreted as a type of measure which determines whether something is long enough to be a word.

The next evidence relating to prosodic structure comes from the verb stem, which may be preceded by several prefixes and which consists of the verb root together with following affixes. Hankamer (1989), who studies morphological parsing in Turkish, evaluates affix-stripping morphological parsing vs. root-driven morphological parsing (in which the parser actively seeks out the root) from both a computational and a psycholinguistic perspective. Agglutinative languages like Turkish (and SiSwati) pose problems for overly simplistic models of processing and lexical access which are based on morphologically simple languages. Hankamer, in studying parsing, makes the assumption, based on Turkish morphology, that the word is root-initial. Thus, in Turkish the choice between root-driven and affix-stripping parsing is basically a choice between left-to-right and right-to-left parsing. He concludes that considerations from both psycholinguistic and computational perspectives point to the advantages of root-driven analysis. Interpreted broadly, this means that identification of the root is a crucial step in parsing. Since in SiSwati the stem generally starts with a root (but is preceded by prefixes), knowing where the left edge of the stem is would help identify the left edge of the root, and thus provide benefits in parsing. So having prosodic structure based on the stem and making the stem prominent would be beneficial. As Cohn and McCarthy (1994) write,

It seems quite plausible that the favored left-edge alignment [of the root with the prosodic word, for Indonesian] has an explanation in the processing domain, perhaps because the coincidence of a root edge and a conspicuous prosodic word edge favors lexical retrieval.

Although the metrical structure of English is quite different from the prosodic structure of SiSwati, nevertheless Cutler and Norris' observations about lexical access at "strong" syllables seem applicable, although "strong" must be interpreted somewhat differently since "strong" in SiSwati refers to having a consonantal edge of a certain type or to being of a certain length; it does not refer to having a certain vowel quality which appears with stressed vowels. As Cutler (1990, p. 119) suggests,

Thus, native speakers of different languages might use a number of different variants of the same basic type of segmenting device. The metrical segmentation strategy is a specific proposal about how such a device operates for a free-stress language like English. But even in languages with

other prosodic structures there might still be quite similar possibilities for segmentation routines.

Getting back to the verb stem in SiSwati, the prosodic situation in the verb stem is complicated by the fact, which holds throughout the language, that onsets are obligatory in SiSwati except word-initially. Although there is a two-syllable minimality requirement in the stem just as there is in the word as a whole, the stem is different than the word in that minimality does not always hold. The reason for this is perhaps because the stem is usually embedded in a word which is at least two syllables long (simply because of morphological considerations), so even if the stem itself is monosyllabic, the word as a whole is still bisyllabic and hence pronounceable. Evidence for minimality in the stem comes from augmentation. Stems which are constructed from shorter roots may include more material among their affixes than stems which are constructed from longer roots. Again, stem-minimality is a measure of well-formedness, but it is not assumed that prosodic constituents are generalized to occur everywhere. Minimality is simply interpreted as a measure when there is actual evidence of a length-based alternation.

Furthermore, there are edge-based alternations in the stem which seem to make a stronger edge, hence, beneficial for parsing. The edge which is "strong" is not the edge of the morphological stem but rather the edge of some prosodic constituent, which will be argued here to be bisyllabic because of the minimality requirements. Although the exclusion of onsetless initial vowels from the prosodic structure does make a strong left edge for the prosodic domain, this would be problematic for a model of lexical access such as the cohort model (Marslen-Wilson and Welsh, 1978), which begins lexical access at the left edge of words (or stems, presumably, in this case), since the left edge of the prosodic domain actually excludes material which is morphologically part of the root and which must be part of its lexical entry.

The next data relating to prosodic structure come from reduplication. The reduplicant in SiSwati is prefixal and two syllables long. Evidence for bisyllabic minimality comes from forms with shorter roots which have augmentative material in the reduplicant, since the root itself, without suffixes or final vowels, acts as the base for reduplication in SiSwati.

The final data related to prosodic structure come from two of the noun class prefixes, which are reduced unless that would make the word less than two syllables long (ignoring initial onsetless vowels, which, as noted earlier, have a different status in SiSwati than vowels with onsets).

Although there is evidence for prosodic structure in SiSwati from alternations and augmentation, there is no evidence (psychological or neurological) as to how this structure is assigned and parsed by the native speaker – whether by rules, constraints, neural networks, stochastic calculations or some other mechanism. Grammatical rules, constraints, and any such mechanisms are not psychologically valid, they are simply expository devices. In a sense, they are metaphors for language processing. This paper will not deal with the types of metaphors which "build" prosodic structure but rather will be confined to describing linguistic evidence (of the type that can be transcribed) which can be interpreted as support for prosodic structures. Furthermore, in many cases of alternation there is no evidence supporting one or the other form as more basic or "underlying." As such, the alternations will simply be stated, without choosing one or the other as underlying.

The paper is organized as follows. In section 2, background information on the phonology and morphology of SiSwati is given in order to enable the reader to understand the examples. In section 3, examples of word-minimality which point to bisyllabic minimality are given, using data from imperative formation. In section 4, the phonological patterns in the stem which point to a bisyllabic prosodic domain in the stem are presented.

Such data include stem-minimality data from passive formation, evidence from tonal phenomena, and edge effects (including a case of complementary distribution and a case of palatalization). Section 5 entertains the question of whether there is evidence for overlapping prosodic domains. In section 6, minimality data from reduplication are discussed. Finally, in section 7, minimality data from two of the noun-class prefixes are discussed.

2 Background Information on SiSwati

2.1 Phoneme Inventory

SiSwati has a canonical five-vowel system, consisting of the vowels /a e o i u/. Only the three non-high vowels may occur root-initially in verbs.

SiSwati has a rich consonant inventory, as shown in (3). In this table, /p' t' k' ɕ'/ are ejectives and /b d g v j fi ɬ ɕ dv/ are depressor consonants. The consonants listed as [ts^h] and [tʃ] are allophonic, with [tʃ] occurring before labials and [ts^h] occurring elsewhere.

(3)

	labial	coronal	dorsal	laryngeal
stop	p ^h p' b b'	t ^h t' d d'	k ^h k' g	
fricative	f v	s ʃ ɬ ɕ	ʃ	h fi
affricate		ts ^h /tʃ dv	ɕ' j	
click		c ^h ɕ	c	
nasal	m	n	ny	ŋ
approx.		l		

2.2 Syllable Structure

Onsets are maximized. This means that all consonants are syllabified into the onset, which may contain up to three consonants. Coda consonants are not allowed. As discussed below, although there are morphemes that end in consonants, such morphemes are always followed by another morpheme that begins with a vowel, allowing the consonant to be syllabified as an onset. Hiatus is not allowed. Hiatus is resolved by glide formation of the first vowel if it is high and deletion of the first vowel otherwise.

2.3 Tone

High and Low tones may occur anywhere in a word. Voiced stops, voiced fricatives, and sometimes /l m w y/ are depressor consonants. In words where the onset of the expected tone-bearing syllable is a member of the class of depressor consonants, the H tone is realized one syllable to the right of its position in words of the same length that do not contain depressor consonants. This phenomenon, however, does not occur when the onset of the following syllable is a depressor consonant. A H tone surrounded by two depressor consonants is realized as a rising tone. H tones on the penult¹ are realized as Falling tones. Tone will not be transcribed here except in the section dealing with tonal phenomena.²

¹ The penult is longer than other syllables on words in isolation but is not longer on phrase-medial words, implying that it is phrase-level lengthening.

² Bradshaw (1996) gives a comprehensive account of tone in SiSwati in which she argues for H, M, and L tones, where the L tones involve depression and the M tone is phonologically unspecified.

2.4 Verb Structure

SiSwati has agglutinative morphology. Much of the evidence presented in this paper comes from the "verb complex," a morphologically complex word. The verb complex consists of prefixes; the root; verbal suffixes (called "extensions"), of which there can be several concatenated together; and a final vowel, of which there is only one (it is obligatory and is always the last suffix).

- (4) subject prefix + object prefix + verb root + verbal suffix + final vowel

Prefixes include subject concords and object concords. There are 13 noun classes in SiSwati (including the infinitive), each of which has its own subject and object markers. Thus the verb may show agreement with the noun class of the subject and with the noun class of the object. Prefixes may also include such tense markings as the progressive [ya-] and the future [t'au-].³

Roots may be either H-toned or toneless. Roots may have any of the different shapes shown in (5), but they are always consonant-final. This is not prosodically well-formed (since codas are not allowed), but the root never occurs alone, always with a final vowel or a suffix. ("C" stands for one or more consonants.)

- (5) -C- -CVC- -CVCVC-
 -VC- -VCVC- -VCVCVC-

The verbal suffixes known as extensions include such categories as the applied /-e/ (known as "benefactive" in non-Bantu languages), the causative /-is/, the reciprocal /-an/, and the perfective /-ile/. Final vowels, which occur after verbal suffixes, include such categories as the positive indicative /-a/, the subjunctive /-e/, and the negative /-i/. Some examples of verb complexes are given in (6).

- (6)
- | | | | | | |
|------------------------|----------------------|--------------------|-----------------------|--------------------|--------------------|
| a. kulima: | ku | lim | a | | |
| "to plow" | <i>infinitive</i> | <i>root</i> | <i>final vowel</i> | | |
| b. kugalimi : | ku | ŋa | lim | i | |
| "to not plow" | <i>infinitive</i> | <i>neg. marker</i> | <i>root</i> | <i>final vowel</i> | |
| c. kulimisa : | ku | lim | is | a | |
| "to cause to plow" | <i>infinitive</i> | <i>root</i> | <i>causative</i> | <i>final vowel</i> | |
| d. kulimisana : | ku | lim | is | an | a |
| "to cause e/o to plow" | <i>infinitive</i> | <i>root</i> | <i>causative</i> | <i>reciprocal</i> | <i>final vowel</i> |
| e. njyalima : | ŋi | ya | lim | a | |
| "I plow" | <i>1st sg. subj.</i> | <i>progressive</i> | <i>root</i> | <i>final vowel</i> | |
| f. njayilima : | ŋi | ya | yi | lim | a |
| "I plow it (a field)" | <i>1st sg. subj.</i> | <i>progressive</i> | <i>class 9 object</i> | <i>root</i> | <i>final vowel</i> |

"Stem," a morphological construct, refers to the root and any following material, including suffixes and final vowels. For a more thorough treatment of SiSwati verb structure, see Ziervogel and Mabuza (1976) or Taljaard, Khumalo, and Bosch (1991).

³ An alternative transcription is [t'awu], which does not contradict the generalization that hiatus is prohibited in SiSwati.

3 Word minimality

There is no word in SiSwati that is shorter than two syllables long. (With a word in the phonological sense being something which can stand by itself.) Usually, satisfying bisyllabic minimality is not an issue in building the verb complex since there is usually at least one prefix and one final vowel, adding up to two syllables. However, imperatives may occur without prefixes.

(7)

a. ku-bon-a	to see	e. bon-a	see!
b. ku- <i>ba</i> -a	to write	f. <i>ba</i> -a	write!
c. ku-lim-a	to plow	g. lim-a	plow!
d. ku-bal-a	to count	h. bal-a	count!

If there is an imperative of a verb root consisting of a single consonant, without any prefixes, then that would be one syllable long, which would be sub-minimal. This situation is averted by the use of an extra syllable, [-ni] in just the cases which would otherwise be too short (seen in the representative forms in (8f-j)). Augmentation of shorter forms can be seen in a comparison of the imperatives of -C- verb roots like [-k^h-] (8g) with the imperatives of -CVC- and longer verb roots (as in the representative forms shown in (7e-h)).

(8)

a. ku-y-a	to go	f. y-a-ni	go!
b. ku-k ^h -a	to pick	g. k ^h -a-ni	pick!
c. ku-b-a	to be	h. b-a-ni	be!
d. ku-ts ^h -a	to say	i. ts ^h -a-ni	say!
e. ku- <i>ḡ</i> -a	to eat	j. <i>ḡ</i> -a-ni	eat!

It is not simply the case that -C- verbs automatically require the longer form of the imperative, as seen by -C- verbs which take either an object prefix or a negative prefix. Representative examples of -C- verbs like [-*ḡ*-] when they are in the imperative with object prefixes or negative prefixes are shown in (9). These verbs, in which the verb complex is at least two syllables long, do not have the extra syllable [-ni-]. Thus, the use of the longer form with [-ni-] in it is dependent on the actual structure of the verb complex, not on the shape of the verb root itself. That is, the criterion for using the syllable [-ni-] is whether the word itself is one syllable long or not, not whether the verb root is of the form -C-. (Unfortunately, the only forms available to show this here are either in the subjunctive with final vowel [-e] or in the negative with final vowel [-i], making them not entirely comparable to the forms in (7) and (8) which have final vowel [-a].)

(9)

a. gu- <i>ḡ</i> -e	(go ahead and) eat it! (the food)	b. uḡa-f-i	don't die!
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Examples of -CVC- verbs like [-bal-] with object prefixes and negative prefixes are shown in (10) for comparison with (9).

(10)

a. t'i-bal-e	(go ahead and) count them! (the shoes)	b. uḡa-bal-i	don't count!
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What might at first glance appear to be evidence contradicting the point illustrated by the data in (9) comes from the plural marker in the imperative, which is also the syllable [ni].

(11)

a. ku-bal-a	to count	b. bal-a-ni	count! (pl.)
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Use of augmentative [-ni-] occurs even with the plural marker [-ni-].

(12)

- | | | | |
|-----------|----------|--------------|--------------|
| a. ku-m-a | to stand | c. m-a-ni-ni | stand! (pl.) |
| b. ku-ḡ-a | to eat | d. ḡ-a-ni-ni | eat! (pl.) |

However, this could be explained if the plural marker were outside of the phonological unit, perhaps acting as a clitic. The tonal data on this point are ambiguous. In the imperative of toneless verbs, there is a H tone on the penult unless that is also the stem-initial syllable, in which case the H tone is on the final syllable.

(13)

- | | | | |
|---------|-------|-----------|-----------|
| a. limá | plow! | b. liméla | plow for! |
|---------|-------|-----------|-----------|

Furthermore, the augmentative syllable does not receive a H tone, even if that means that the H must be on the stem-initial syllable.

(14)

- | | | |
|---------|-----|----------|
| a. yáni | go! | b. *yaní |
|---------|-----|----------|

Given these two facts of tone assignment, the plural imperative could be interpreted either way. Either the [ni] is part of the unit and the H is on the penult or else [ni] does not count as part of the phonological unit but the H is avoiding the stem-initial syllable.

(15)

- | | | | |
|-----------|------------|-----------|-------------|
| a. bicáni | mix! (pl.) | b. limăni | plow! (pl.) |
|-----------|------------|-----------|-------------|

Further data about the status of the plural marker come from penult-lengthening. Although it is the syllable before [-ni-] which is lengthened and that is the penultimate syllable in the word (which might be interpreted as implying that the [-ni-] is being included in the phonological word), what might actually be happening is that it is the phrase penult which is lengthened and not the word-penult. In that case the lengthening would imply that the suffix is excluded from the phonological word but that it is included in the phonological phrase. Thus the data about [-ni-] will not be taken as contradictory data, and it will be maintained that the augmentative [-ni-] in the imperative is only used if the word itself is less than two syllables long.

4 The Verb Stem

Downing (1994, 1995) argues for a prosody/morphology mismatch in SiSwati (based on data from reduplication and tone). She postulates the existence of a "prosodic stem," which is an unbounded prosodic structure related to, but not isomorphic with, the morphological stem. In the following examples from Downing, the symbols () mark the "prosodic stem" while the symbols [] mark the morphological stem.

(16)

- | | | | |
|-------------------|-------------|-----------------|------------|
| a. [(khulúma)] | talk | c. [(tfútsa)] | move house |
| b. [e(hlukánisa)] | distinguish | d. [e(tsaméla)] | bask |

It will be shown below that minimality data, tonal effects, and edge effects show that onsetless vowels are excluded from the prosodic entity (called the "prosodic stem" by Downing) while they are included in the morphological stem. So, as Downing claims, there is some prosodic entity present that is not isomorphic with the stem. Minimality data presented below, though, argue for this prosodic entity being bisyllabic, not an unbounded "prosodic stem" as Downing claims. None of the data presented here require an unbounded "prosodic stem." In this section, evidence for the bisyllabicity of the prosodic structure of the stem will be shown based on minimality considerations, followed by a discussion of edge effects which support the existence of prosodic structure in the stem.

4.1 Stem Minimality

At the stem level, there are many examples where the stem (root and following material) is less than two syllables long. Any example with a -C- root and a single final vowel constitutes an example. For example, in (17) the infinitive prefix [ku] does not count as part of the stem, leaving only [-Ca-] (which is one syllable) in the stem. In such cases, there is no augmentation.

(17)

a. ku-ḡ-a	to eat	e. ku-f-a	to die
b. ku-lw-a	to fight	f. ku-k ^h -a	to pick
c. ku-y-a	to go	g. ku-m-a	to stand
d. ku-w-a	to fall		

Thus, the stem does not manifest the same kinds of minimality requirements that the whole word does. However, in a certain class of examples, shorter roots take a different (longer) form of the affix than longer roots do. For example, roots consisting of a single consonant have the form C-i-w-a in the passive, where C is the root and [a] is the final vowel. The [-i-] can be interpreted as an augmentative element.^{4,5} The crucial difference between the examples in (17) and (18) is that in (18) a single vowel more among the affixes (where "more" means more as compared with what appears among the affixes in the passive form of longer roots) makes the stem bisyllabic, since the /w/ of the passive can provide an onset. On the other hand, an entire syllable more (again, with "more" meaning more as compared with what appears among the affixes in the infinitive of longer roots) would be needed to make the stem of the infinitive forms bisyllabic. Although both a vowel and an entire syllable change the prosodic structure and the syllable count of the affixes when comparing shorter and longer roots, it seems that a difference of an entire syllable might be too "expensive" prosodically at the level of the stem, especially since the word itself, including the prefix, is bisyllabic anyhow and hence pronounceable as a word. The implication is that the presence of the longer form is not due to the passive construction *per se*, but rather to the fact that the passive suffix only needs one vowel to make the difference between shorter and longer affixes, since there is a single consonant present either way which can serve as a syllable onset.

(18)

a. banana wa-k ^h -i-w-a	the banana was picked
b. lubisi lwa-ḡ-i-w-a	the milk was eaten
c. imali ya-ph-i-w-a	the money was given

The bisyllabic domain would begin at the left edge of the stem (although with these examples it is not crucial whether it is the left or the right edge of the stem, see (35) for evidence in this regard). In the following examples, square brackets indicate the presence of a prosodic domain.

⁴ The [-i-] which augments the passive suffix [-w-] is the most constricted, and hence least vowel-like, vowel, which seems to involve the least amount of displacement of the articulators between consonants and so is chosen as the contentless augmentative element. Although [-u-] is just as constricted height-wise as [-i-], it involves the additional activity of lip-rounding. Other languages which choose [-a-] as the epenthetic element might be choosing the most sonorous, most vowel-like sound as epenthetic. The choice of [ə] as the epenthetic element in some languages may involve reinterpretation of a consonant burst as a vocalic element (suggested by Beckman, *p.c.*).

⁵ Alternatively, the [i] could be part of the lexical entry for the suffix but reduced everywhere except where that would make the stem subminimal. A third alternative is just to state that the passive suffix is [iʷ] with shorter stems and [w] with longer stems, without choosing which is more basic or underlying.

(19)

- | | |
|-------------------------------|------------|
| a. wa-[k ^h -i-w-a] | was picked |
| b. lwa-[ɣ-i-w-a] | was eaten |
| c. ya-[p ^h -i-w-a] | was given |

Longer roots which are CVC or longer, like [-bon-], simply have the suffix [w] in the passive. Notice that there are voiceless obstruents (20f,g) just before the passive suffix, exactly as there were in (18) above. In (20), the -C-w- sequences are onsets, since all consonants are syllabified into the onset in SiSwati. The -C-w- sequences in (18) which would have arisen without the [-i-] would have been perfectly syllabifiable as onsets. Thus the presence of [i] in (18) cannot be driven by syllabification, because if it were, then one would expect a similar pattern, with C-i-w-a, in (20f-g) as well.

(20)

- | | |
|---|--------------------------|
| a. indvodza ya-bon-w-a | the man was seen |
| b. ingu ya-pend-w-a | the house was painted |
| c. t'ing ^h uni t'a-bondv-w-a | the firewood was chopped |
| d. lipot'o la-mbonjot'-w-a | the pot was covered |
| e. umntfwana wa-p ^h ekel-w-a | the child was bothered |
| f. luswat'i lwa-goč-w-a | the small stick was bent |
| g. umfat'i w-etfuk-w-a | the woman was insulted |

Roots which are of the form -VC- pattern with roots of the shape -C- in that they have an [i] in the passive suffix, indicating the exclusion of the initial vowel from the prosodic structure of the stem. In (21), even though the initial vowel is morphologically part of the stem in that it must be part of the lexical entry of the stem, it is not counted toward satisfying bisyllabic minimality in the stem. For example, the root in (21a) is [-ok^h-], which appears with the noun-class prefix [wa-]. However, [wok^hwa] does not satisfy bisyllabic minimality. Thus, the morphological structure alone is not adequate to describe the pattern, indicating that prosodic structure is also necessary.

(21)

- | | | | |
|---------------------------|-----------|------------------------------------|------------------------|
| a. k-ok ^h -a | to light | h. umlilo w-ok ^h -i-w-a | the fire was lit |
| b. k-os-a | to roast | i. inyama y-os-i-w-a | the meat was roasted |
| c. kw-al-a | to refuse | j. imali y-al-i-w-a | the money was refused |
| d. kw-ak ^h -a | to build | k. ingu y-ak ^h -i-w-a | the house was built |
| e. kw-ets ^h -a | to pour | l. emanti ets ^h -i-w-a | the water was poured |
| f. kw-eb-a | to steal | m. imbut'i y-eb-i-w-a | the goat was stolen |
| g. kw-el-a | to winnow | n. umhila w-el-i-w-a | the maize was winnowed |

Here the bisyllabic domain would begin not at the left edge of the stem, but at the first onset in the morphological stem. The square brackets show the location of the prosodic domain.

(22)

- | | |
|-------------------------------|-------------|
| a. w-o[k ^h -i-w-a] | was lit |
| b. y-o[s-i-w-a] | was roasted |
| c. w-e[mb-i-w-a] | was dug |

Again, it is not crucial if this prosodic domain is constructed at the left edge of the stem (but ignores material which is syllabified with non-stem material) or whether the prosodic domain is constructed at the right edge of the stem. The problem is that the only time there is evidence at all for prosodic structure with the passive construction is when the longer form of the passive suffix is used: [Ciwa] or V[Ciwa]. Thus there is crucially a lack of evidence as to where the prosodic domain begins. A different type of evidence, discussed

below in (35), shows that the domain must in fact be at the left edge of the morphological stem, not at the right edge.

Downing states a minimality requirement in terms of the inclusion of at least one root vowel in the prosodic stem. However, as shown above in (21), the prosodic structure does not include the root vowel (as shown by the presence of the longer form of the passive with -VC- verbs), although it does include final vowels in satisfying bisyllabic minimality.

The exclusion of the initial onsetless vowel from the prosodic structure of the stem can be compared with imperatives of -VC- verbs, which take the shorter allomorph (as seen in the representative forms in (23)). The fact that they are vowel-initial can be seen from their infinitives, which show the coalesced form of the infinitive prefix [ku]. These forms just have the final vowel, without the augmentative syllable [-ni-]. (Recall that subminimal forms in the imperative take a longer form of the imperative suffix with the additional syllable [ni]. See in (8) above.) This implies that they are already two syllables long, so the initial vowel must be included in the syllable count.

(23)

a. kw-ak ^h -a	to build	i. y-ak ^h -a	build!
b. kw-ab-a	to share	j. y-ab-a	share!
c. k-ok ^h -a	to light	k. y-ok ^h -a	light!
d. k-on-a	to damage	l. y-on-a	damage!
e. kw-ets ^h -a	to fill up	m. y-ets ^h -a	fill up!
f. kw-el-a	to winnow	n. y-el-a	winnow!
g. kw-endz-a	to marry	o. y-endz-a	marry!
h. kw-eng-a	to surpass	p. y-eng-a	surpass!

The initial [y-] in the examples in (23) is epenthetic. Although the epenthetic [-y-] might seem to be preventing the verb complex from being vowel initial, the situation is actually more complicated since there are in fact vowel-initial prefixes which do not take initial [y-] (seen in (24)). This cannot be a restriction forcing stems to be consonant-initial either, since there are in fact vowel-initial stems which must be listed as such. The generalization seems to be that [-y-] occurs only when a vowel-initial stem would otherwise be word-initial.

(24)

a. u-fik-ile	he arrived	c. a-ŋi-bon-i	I don't see
b. u-budz-ile	he dreamed	d. a-ŋi-ɬal-i	I don't write

In summary, the stem also shows a bisyllabic minimality effect, although the effect is more intricate than the word-minimality effects, since factors like the syllabification of onsetless vowels with prefixes must be taken into account.

4.2 Tonal effects

Another effect of the prosodic domain is in the area of tone. Toneless verbs whose stem is longer than bisyllabic have a H tone on the penult in the remote past tense (which is realized as F). The other H or R tone is contributed by the prefix, for example in (25a) by [á], where [wá] is a fusion of [u + á] and [u] is the third singular marker.

(25)

a. wá-ɬakûl-a	s/he weeded
b. ŋǎ-ɬakûl-a	I weeded
c. sǎ-lim-el-ǎn-a	we plowed for each other

Toneless verbs whose stem is two syllables long or shorter have a H tone on the final syllable.

(26)

a. wá-lim-á	s/he plowed	c. wā-y-á	s/he went
b. ṅá-lim-á	I plowed	d. wā-b-á	s/he was
		e. wā-ts ^h -í	s/he said

This is again a length-based phenomenon. In general, the H tone is realized on the penult. In the shorter cases in (26 a-b), there are two possible generalizations accounting for realization of grammatical H on the final syllable instead of on the penult (in two syllable words the H is on the final syllable because that is the only available syllable):

(27)

a. a general avoidance of having the grammatical H tone on the first syllable of the prosodic domain;

b. an obligatory contour principle (OCP) effect causing the H of the subject marker and the grammatical H to be non-adjacent.

Toneless verb roots which are vowel-initial and whose stem is three syllables long have a H tone on the final syllable, not on the penult (as seen in (28)). This evidence could support either hypothesis (a) or (b). This could be a general avoidance of the first syllable of the prosodic domain (which is marked with the symbols [J], with the initial onsetless vowel excluded from the prosodic domain. On the other hand, due to resolution of hiatus, the [-a-] of the subject prefix is not realized, which would cause an OCP violation if the H of the grammatical tone were realized on the penult.

(28)

a. w-é[lap ^h -á]	s/he healed	d. w-é[ṅget'-á]	s/he added
b. w-é[tfuk-á]	s/he was surprised	e. w-é[ṅgul-á]	s/he skimmed off
c. w-é[ṅgam-á]	s/he towered over	f. w-é[lus-á]	s/he herded

Thus, more evidence is needed to decide which of the generalizations about shorter stems is correct. If hypothesis (b) were the case, one might expect the second H tone to not surface at all in (26d-f), since the H is adjacent to another H tone, violating the OCP. Another argument against hypothesis (b) is that adjacent H tones are in fact tolerated in SiSwati in other forms, such as in the infinitive.

(29)

a. kú-lúm-a	to bite
b. kú-ts ^h én-a	to buy

What would be needed to make the case for either hypothesis (a) or hypothesis (b) would be if there were a toneless prefix, for example, [u + a = wa] instead of the actually occurring [u + á = wá]. Then if the grammatical H still appeared on the final syllable, for example in [wa-lim-á], then a general restriction on having the H on the first syllable of the prosodic domain could be implicated in the realization of the H on the final syllable. If, on the other hand, there were a toneless prefix like [wa] and the grammatical H appeared on the penult, for example as [wa-lim-a], then the OCP could be implicated in the realization of the H on the final syllable in (26). That is, if the H tone appeared on the final syllable only when it would otherwise be adjacent to another H tone, then that would be motivation for citing an OCP effect. However, all of the prefixes have either a high tone or a rising tone, making it impossible to test these two ideas against each other.

(30)

- | | | | |
|-------------|----------------|-------------|-----------------|
| a. ŋá-lim-á | I plowed | d. sǎ-lim-á | we plowed |
| b. wǎ-lim-á | you(sg) plowed | e. nǎ-lim-á | you(pl.) plowed |
| c. wá-lim-á | he plowed | f. bá-lim-á | they plowed |

Thus, both proposals are viable, but there is some evidence against the OCP account, indicating that the proposal which makes reference to the first syllable of the prosodic domain is to be preferred, especially given the other evidence for the prosodic domain.

4.3 Edge Effects at the the Stem Level

4.3.1 Distributional Evidence

[ŋg] and [ŋ] are in complementary distribution. [ŋg] appears as the onset of stem-initial syllables and [ŋ] appears everywhere else.

(31)

- | | | | |
|-----------------|----------|--------------|----------|
| a. ku-ŋgabat'-a | to doubt | b. ku-ŋgen-a | to enter |
|-----------------|----------|--------------|----------|

[ŋ] appears as the onset of syllables which are not stem-initial.⁶ The [ŋ] may be the onset to a stem medial syllable (as in (32e)) or it may be the last part of the root which surfaces as the onset of the stem-final syllable with the addition of the final vowel (as in (32a-d)).

(32)

- | | | | |
|-----------------------------|-----------|------------------|----------|
| a. ku-ḥoŋ-a | to bellow | d. ku-seŋ-a | to milk |
| b. ku-ceŋ-a | to filter | e. ku-biŋel-el-a | to greet |
| c. ku-ts ^h ceŋ-a | to buy | | |

Thus, the appearance of [ŋg] vs. [ŋ] serves as a diagnostic which gives evidence about the left edge of the prosodic constituent.

This distribution seems to give a strong edge to the prosodic constituent. Having a strong edge could be beneficial for parsing by helping to identify the left edge of the root and hence the left edge of the stem. Ohala (1992) writes that "...as the closure gets further back the nasal consonants that result get progressively less consonantal." Thus, having a release burst (due to closure of the velum before the vowel begins) may serve to make [ŋg] a better, more consonantal, edge for the prosodic domain because of the perceptual salience of the burst. The [ŋ], which does not have a release burst because of the lack of pressure build-up in the oral cavity (due to nasal airflow releasing pressure), does not make as good an edge. Again, this can be described simply as a distribution, not a lenition medially or a fortition stem-initially, although there is in this case one argument that it is a lenition since [ŋ] acts a depressor with the class of depressors often defined as voiced obstruents (Bradshaw, 1996).

This distribution applies only to the stem, not to the word, because there are subject prefixes beginning with [ŋ] which appear word-initially.

(33)

- | | |
|------------------|-------------|
| a. ŋi-t'au-lim-a | I will plow |
| b. ŋi-t'au-lum-a | I will bite |
| c. ŋi-bon-a | I see |

⁶ Stems which seem to have lexicalized reduplication may have [ŋg] stem-internally, as in (a) and (b) below, but these could be interpreted as having [ŋg] at the edge of the reduplicant as well as [ŋg] at the edge of the stem. However, these lexicalized examples do not have the general shape of reduplicants discussed in section 6.

a. ku-ŋgiŋgit'-a	to stammer
b. ku-ŋgiŋgiŋgit'-a	to skim

With vowel-initial stems, since hiatus is not tolerated and glide-formation or deletion result, the initial vowel of the root is syllabified with the prefix. (The /u/ of the infinitive prefix /ku-/ surfaces as a glide before a vowel, but does not surface before /o/.) Even though this vowel is syllabified with the prefix, morphologically it is still part of the stem (which, as noted above, is a morphological entity). The evidence from the distribution of [ŋg] vs. [ŋ] shows that the stem-initial vowel is excluded from the prosodic domain, since it is [ŋg] which appears after the initial vowel (even though in (34d) and (34e) this means that there is positive evidence that the stem is sub-minimal). Referring to the "stem" is not adequate here since the vowel is part of the morphological stem but is not part of the prosodic structure based on the stem. Thus, reference to a prosodic construct, namely to the prosodic domain which is motivated above by the minimality effect, must be made in order to explain the appearance of [ŋg] as the onset of a syllable which is not stem-initial.

- (34)
- | | | | |
|----------------|---------------|-------------|-----------------|
| a. kw-engam-a | to tower over | d. kw-ang-a | to hug and kiss |
| b. kw-egget'-a | to add | e. k-ong-a | to economize |
| c. kw-eggul-a | to skim off | | |

Evidence here does show that the prosodic constituent must occur at the left edge of the stem and not at the right edge because left-edge effects are seen even in longer forms. In (35a) for example, the prosodic domain is at the left edge of the stem so the initial onset of the prosodic domain is "strong" (it has an oral release burst). In (35b), on the other hand, the prosodic domain extends two syllables from the right edge of the stem. In this case, the stem-initial onset [ŋ] would not be the prosodic-domain-initial onset, so it would not be "strong." This would yield the incorrect form.

- (35)
- | | | |
|-------------------|----------|-------------------|
| a. ku-[ŋgaba]t'-a | to doubt | b. *ku-ŋa[bat'-a] |
|-------------------|----------|-------------------|

4.3.2 Palatalization Edge Effects

Labial consonants which are not stem-initial are palatalized in the passive form. A labial consonant which is root-final (36) or root medial (37) (neither of which is stem-initial) is palatalized in the passive. The infinitive forms are shown below each passive to motivate the claim that there is an alternation between a labial consonant and a palatal consonant.

- (36)
- | | |
|----------------------------|------------------------|
| a. indvodza y-elaf-w-a | the man was healed |
| b. kw-elap ^h -a | to heal |
| c.inja ya-nɕwač-w-a | the dog was buried |
| d. ku-nɕwab-a | to bury |
| e. luswat'i lwa-goč-w-a | a small stick was bent |
| f. ku-gob-a | to bend |
| g. umuntfu w-esač-w-a | the person was afraid |
| h. kw-esab-a | to be afraid |
| i. umuno wa-luny-w-a | the finger was bitten |
| j. ku-lum-a | to bite |
| k. insimu ya-liny-w-a | the field was plowed |
| l. ku-lim-a | to plow |

m. umntfwana wa-lany-w-a	baby born after you
n. kw-elam-a	to come after
o. umntfwana wa-banj-w-a	the child was held
p. ku-bamḁ-a	to hold
q. umntfwana wa-meny-w-a	the child was carried on the back
r. ku-mem-a	to carry
(37)	
a. lipot'o la-mbonjot'-w-a	the pot was covered
b. ku-mḁomḁot'-a	to cover
c. t'inḁebe t'a-ḁojos-w-a	ears were pierced
d. ku-ḁobos-a	to pierce

However, labials which are stem-initial (and root-initial) are not palatalized.

(38)	
a. inḁu ya-pend-w-a	the house was painted
b. ku-pend-a	to paint
c. umuntfu wa-p ^h ucul-w-a	the person was civilized
d. ku-p ^h ucul-a	to civilize
e. umtfwana wa-p ^h ekel-w-a	the child was bothered
f. ku-p ^h ekel-a	to bother
g. imali ya-p ^h i-w-a	the money was given
h. ku-p ^h a	to give
i. umsebenti wa-p ^h awul-w-a	the work was distinguished
j. ku-p ^h awul-a	to distinguish
k. emanti a-bilis-w-a	the water was boiled
l. ku-bilis-a	to boil
m. indvodza ya-bon-w-a	the man was seen
n. ku-bon-a	to see
o. umntfwana wa-banj-w-a	the child was held
p. ku-bamḁ-a	to hold
q. umntfwana wa-meny-w-a	the child was carried on the back
r. ku-mem-a	to carry

Labials which are preceded only by an onsetless syllable, but where the labial is the first onset in the stem, also are not palatalized. Again, this is evidence that the stem-initial onsetless vowel, which is syllabified with the prefix but is morphologically part of the stem, is not included in the prosodic domain. So referring to the "stem" is inadequate, because the "stem" is a morphological entity which does include the initial vowel, but according to the distribution of labials in the passive forms, the initial vowel is prosodically excluded.

(39)

- | | |
|---|--------------------------|
| a. imot'o y-ebolek-w-a | a car was borrowed |
| b. kw-ebolek-a | to borrow |
| c. sitata s-ebul-w-a | the tree was peeled |
| d. kw-ebul-a | to peel |
| e. emanti ab-i-w-a | the water was shared out |
| f. kw-ab-a | to share |
| g. babe w-embul-w-a | the father was uncovered |
| h. kw-embul-a | to uncover |
| i. t'infuku t'-omis-w-a | the nut was made dry |
| j. k-omis-a | to dry |
| k. insondvo y-ep ^h otf-w-a | the wool was twisted |
| l. kw-ep ^h ots ^h -a | to twist |

There are stems beginning with palatal consonants, so the restriction on palatalizing stem-initial labials cannot simply be a blanket restriction on stem-initial palatal consonants.

(40)

- | | | | |
|-------------|-------------|---------------|----------------|
| a. ku-faḥ-a | to repair | c. ku-faḍ-a | to get married |
| b. ku-f-a | to be burnt | d. ku-jayiv-a | to dance |

Chen and Malambe (1995), who analyze palatalization in SiSwati, suggest that the passive suffix consists of a floating "palatal" feature. Chen and Malambe's suggestion of a floating feature for palatalization distinguishes underlying stem-initial palatal consonants, which are licit, from stem-initial palatal consonants created by passive palatalization, which are not allowed.

Again, this seems to be an edge effect on the prosodic constituent, preserving the unpredictable stem-initial place of articulation and so making it "stronger" in some sense by making it easier to access.

5 Overlapping prosodic constituents?

It has been argued that there is a prosodic constituent measuring word minimality and a prosodic constituent based on the stem, but since the stem is embedded in the word and usually preceded by prefixes, one possible concern is that the two constituents might overlap. This would be problematic because prosodic structures are not supposed to overlap – that would defeat their organizational purpose. Kisseberth (1994) assumes that domains of a given type do not overlap. He claims that "domain structures such as the following:

...o[x p[ly]o z]p...

are considered ill-formed." In order to get evidence for overlapping prosodic constituents from the stem and word domains, there would need to be a particular configuration giving evidence for both types of structures in the same word. Again, it is not claimed that every word or every stem has a binary prosodic domain imposed on it. The domains are only claimed to occur when there is actual evidence for them. The evidence from the word as a whole is minimality, in the form of the augmentative syllable [-ni-] in the imperative of -C-verbs. The evidence for prosodic structure from the stem is either the augmentative [-i-] in the passive, having a H tone on the final syllable in the remote past tense, the [ŋg]/[ŋ]

distribution, or the distribution of palatalization in passives. Thus [-ni-] would have to appear with one of the other types of evidence. For example, if there were an imperative form of a -C- verb consisting of [-ng-], with the form [ng-a-ni], that would give evidence for prosodic structure for both the word and the stem (even though the two structures in that case could be construed as hierarchically arranged [[ng-a-ni]_{stem}]_{word}, not as overlapping). However, there is no such verb. Or, there could be an imperative form of a passive verb, such as [h-i-w-a] "be eaten!", or an imperative of a remote past tense verb, which cannot be elicited because an imperative can be inflected for neither tense nor subject while a remote past verb would have to be inflected for both tense and subject. In any of these cases, though, the word would have to be exactly two syllables long, but that would not be long enough for a structure like a[syll.1] b[syll.2] a syll.3] b. Thus evidence as to what happens when there are overlapping prosodic constituents is hard to come by, since evidence for having prosodic structure in the word as a whole is limited to -C- root imperatives.

6 Reduplication

In SiSwati, the reduplicant is two syllables long (as noted by Kiyomi and Davis (1992) and by Downing (1994, 1995)). This has been analyzed as a foot-shaped template, but as mentioned above, the primitive notion of "foot" has been decomposed here into the idea of binarity applied to a prosodic domain. Thus the reduplicative template, while it is bisyllabic, is not called a "foot" here. Reduplication adds the meaning of doing something "a little" to the verb. If the root itself is at least as long as CVCVC (remembering that roots themselves are actually always consonant-final), then the reduplicant simply copies the melody of the first two syllables of the root. The reduplicant is underlined in all of the following examples.

(41)

- | | |
|--|------------------------------|
| a. ku-tfuku-tfukuts ^h elisa | to cause to get a little mad |
| b. ku-k ^h ulu-k ^h uluma | to say a little |
| c. ŋi-ya-tfuku-tfukutsela | I get a little mad |
| d. ŋa-tfuku-tfukutsela | I got a little mad |
| e. ŋi-k ^h ulu-k ^h ulumile | I've said a little |
| f. ŋi-ngwingwi-ngwingwilit'ile | I've skimmed a little |
| g. ku-ŋa-tfuku-tfukutseli | to not be a little mad |
| h. ku-ŋa-k ^h ulu-k ^h ulumi | to not say a little |

If the root itself is only of the form -CVC-, then the second vowel in the reduplicant is always [a], no matter what the second vowel of the stem is.⁷ In this regard, note especially examples (42g-i) and (42l), in which the second stem vowel is the [-i-] of the suffix [-ile-] or of the final vowel [-i] but the last vowel in the reduplicant is nevertheless still [-a-]. Thus, the reduplicant seems to have a bisyllabic template in which the root melody is filled in, but it is augmentable with other material if necessary. Here it should be noted that although Downing (1994, 1995) uses two types of evidence for the prosodic stem, reduplication and tone, the base for reduplication is the root itself whereas the application of local shift (a tonal process in which the H is realized one syllable over from where it is morphologically) includes the object prefix and any suffixes.

⁷ Downing (1996) gives examples of -CVC- roots with the benefactive derivational suffix [-el-]. She says that such stems may have either a reduplicant of the form -CVCa- or a reduplicant of the form -CVCe-. She suggests that examples which always have the final vowel [a] in the reduplicant (such as in (42)) are assuming the shape of the "canonical stem" with the "predictable, regular inflectional final suffix."

(42)

- | | |
|--|-------------------------------|
| a. ku- <u>lima</u> -lima | to plow a little |
| b. ku- <u>bona</u> -bona | to see a little |
| c. <u>ni-ya</u> - <u>lima</u> -lima | I plow a little |
| d. <u>ni-ya</u> - <u>bona</u> -bona | I see a little |
| e. <u>ŋa</u> - <u>lima</u> -lima | I plowed a little |
| f. <u>ŋa</u> - <u>bona</u> -bona | I saw a little |
| g. <u>ŋi</u> - <u>k^hula</u> -k ^h ulile | I've grown a little |
| h. <u>ŋi</u> - <u>bona</u> -bonile | I've seen a little |
| i. <u>ŋi</u> - <u>lima</u> -limile | I've plowed a little |
| j. <u>ni-ya</u> - <u>li-bona</u> -bona ligundvwane | I see it a little (a mouse) |
| k. <u>ni-ya</u> - <u>yi-lima</u> -lima ingadze | I plow it a little (a garden) |
| l. ku- <u>ŋa</u> - <u>bona</u> -boni | to not see a little |

There is another effect that motivates positing the root by itself, without suffixes or final vowels, as the "base" of reduplication. If the root (without the final vowel) is at least two syllables long, then the lexical tone is realized on the base, not on the reduplicant. If the root (without the final vowel) is shorter than two syllables, then the lexical tone is realized on the reduplicant, not on the base. This phenomenon supports the idea that there is a "base" for reduplication from which the reduplicant is copied and that the base is the root itself.

(43)

- a. yok^ha-yok^ha roast it a little! b. yok^he-yok^héla roast it (for someone) a little!

The -VC- roots do not fill up the bisyllabic reduplicative template either, just like the -CVC- roots. In these cases also, the second vowel of the reduplicant is [a] no matter what the second stem vowel is. In the forms in (44v-hh), the second vowel of the stem is always [a], even when the second vowel of the stem is [-i-]. This [i] is either part of the perfective suffix [-ile-] (44v-ee) or else the [-i-] of the negative final vowel (44ff-hh).

In the case of reduplication involving -VC- roots, there are two places where hiatus could potentially arise. One place where hiatus could arise is between the reduplicant and the stem. An epenthetic [y-] is used to resolve hiatus here because glide-formation or deletion are not options (glide formation because the first vowel is not high and deletion because that would make the reduplicant less than two syllables long).⁸ Another place where hiatus could arise is between the prefix and the reduplicant. In this case, hiatus is resolved by having the [-u-] of the infinitive prefix be realized as a glide (just as it does in non-reduplicative forms, i.e. (21)).

(44)

- | | |
|---|----------------------|
| a. kw- <u>andza</u> -y-andza | to increase a little |
| b. kw- <u>ala</u> -y-ala | to refuse a little |
| c. k- <u>ok^ha</u> -y-ok ^h a | to light a little |
| d. k- <u>osa</u> -y-osa | to roast a little |
| e. k- <u>ona</u> -y-ona | to damage a little |
| f. kw- <u>ela</u> -y-ela | to winnow a little |
| g. kw- <u>enya</u> -y-enya | to soak a little |
| h. kw- <u>eba</u> -y-eba | to steal a little |

⁸ The epenthetic [y-] is not copied in the reduplicant (as also noted by Downing (1994)), perhaps because it is not morphologically part of the root which is serving as the base for reduplication.

i. η -y- <u>aba</u> -y-aba	I share a little
j. η -y- <u>ala</u> -y-ala	I refuse a little
k. η -y- <u>osa</u> -y-osa	I roast a little
l. η -y- <u>ona</u> -y-ona	I damage a little
m. η -y- <u>ets^ha</u> -y-ets ^h -a	I fill up a little
n. η -y- <u>ela</u> -y-ela	I winnow a little
o. η - <u>andza</u> -y-andza	I increased a little (remote)
p. η - <u>ala</u> -y-ala	I refused a little (remote)
q. η - <u>osa</u> -y-osa	I roasted a little (remote)
r. η - <u>ona</u> -y-ona	I damaged a little (remote)
s. η - <u>ets^ha</u> -y-ets ^h -a	I filled up a little (remote)
t. η - <u>ela</u> -y-ela	I winnowed a little (remote)
u. η - <u>eba</u> -y-eba	I stole a little (remote)
v. η - <u>ak^ha</u> -y-ak ^h ile	I've built a little
w. η - <u>aba</u> -y-abile	I've shared a little
x. η - <u>ala</u> -y-alile	I've refused a little
y. η - <u>ok^ha</u> -y-ok ^h ile	I've lit a little
z. η - <u>osa</u> -y-osile	I've roasted a little
aa. η - <u>ona</u> -y-onile	I've damaged a little
bb. η - <u>ets^ha</u> -y-ets ^h ile	I've poured a little
cc. η - <u>ela</u> -y-elile	I've winnowed a little
dd. η - <u>enca</u> -y-encile	I've surpassed a little
ee. η - <u>eba</u> -y-ebile	I've stolen a little
ff. ku- η - <u>ala</u> -y-ali	to not refuse a little
gg. ku- η - <u>osa</u> -y-osi	to not roast a little
hh. ku- η - <u>ela</u> -y-eli	to not winnow a little
ii. η -ya-y- <u>ak^ha</u> -y-ak ^h a in η u	I build it a little (a house)
jj. η -ya-s- <u>ak^ha</u> -y-ak ^h a sit'ulo	I build it a little (a stool)
kk. η -ya-t'- <u>aba</u> -y-aba t'icoko	I share them a little (hats)
ll. η -ya-y- <u>ala</u> -y-ala imbuya	I refuse it a little (kind of vegetable)
mm. η -ya-y- <u>ok^ha</u> -y-ok ^h a imot'o	I light it a little (a car)
nn. η -ya-w- <u>ok^ha</u> -y-ok ^h a umlilo	I light it a little (a fire)
oo. η -ya-y- <u>osa</u> -y-osa inyama	I roast it a little (meat)
pp. η -ya-w- <u>osa</u> -y-osa umbila	I roast it a little (corn)
qq. η -ya-l- <u>ela</u> -y-ela liheleyisi	I winnow it a little (ground dry corn)
rr. η -ya-y- <u>ets^ha</u> -y-ets ^h a imot'o	I fill it up a little (the car)

Below, it will be shown that in -C- roots, the augmentative [-a] is not enough to fill the bisyllabic reduplicative template, so an entire augmentative syllable [yi] is used. The question is whether the [y-] seen between the reduplicant and the base in (44) should be analyzed as (a reduction of) the epenthetic syllable [yi-]. Evidence that this is just an epenthetic [y] resolving hiatus and not an augmentative syllable comes from longer vowel-initial words, where the [y] is still inserted between the reduplicant and the stem. Although there are very few underived 3-syllable or longer vowel-initial stems, there is one example provided by Downing which fits these criteria and which does still show a [y] between the reduplicant and the base, indicating that the [y] is used simply to resolve hiatus.

(45)

a. η -ona-yonákala

get spoil

If the root is even shorter, namely, -C-, then the reduplicant is of the form C-a-yi, as first noted by Ziervogel and Mabuza (1976) and analyzed by Kiyomi and Davis (1992) to be a

constraint on the form of the reduplicant. The same [y] is used as epenthetic in imperatives and in vowel-initial roots in reduplication and the same [i] is seen as augmentative in passives. It is interesting that the syllable [-ni-] is used to satisfy word-minimality, while the syllable [yi] is used in the reduplicant. This seems to reinforce the idea that the derivational morphology of the reduplicant is a distinct morphological domain. The problem is accounting for the [a] in the reduplicant. Why is the reduplicant C-a-yi and not C-i-yi or C-i-ya? It might be suggested that the base for reduplication, besides being specified as a root, must also be a unit, namely, a syllable. This would explain (46a-f) and (46h-i), which contain the syllable [Ca] in the base, but not the perfective form in (46g) and the negative form in (46j), which have instead the syllable [Ci] in the base. This is left as an open problem.

(46)

- | | |
|---|------------------------------------|
| a. ku-k ^h ayi-k ^h a | to pick a little |
| b. ku- <u>kayi</u> -ʒa | to eat a little |
| c. ŋi-ya-k ^h ayi-k ^h a | I pick a little |
| d. ŋi-ya- <u>kayi</u> -ʒa | I eat a little |
| e. ŋa-k ^h ayi-k ^h a | I picked a little (remote) |
| f. ŋa- <u>kayi</u> -ʒa | I ate a little (remote) |
| g. ŋi-k ^h ayi-k ^h ile | I've picked a little |
| h. ŋi-ya-t'i-k ^h ayi-k ^h a t'ĩŋcozi | I pick it a little (kind of fruit) |
| i. ŋi-ya-wa-k ^h ayi-k ^h a emanti | I fetch it a little (water) |
| j. ku-ŋa-k ^h ayi-k ^h i | to not pick a little |

One remaining problem is that verbs with initial [e-] may show infixing reduplication.

(47)

- | | | | |
|--------------------------------|----------------------|--|------------------|
| a. kw-e-tfuka-tfuka | to surprise a little | d. kw-e-lusa-lusa | to herd a little |
| b. kw-e- <u>ɬuka</u> -ɬukanisa | to divide a little | e. kw-e- <u>lap^ha</u> -lap ^h a | to heal a little |
| c. kw-e- <u>nɰula</u> -nɰula | to pass by a little | | |

On the basis of the infixation, Downing (1994, 1995) motivates a morphology/prosody mismatch. She claims that the initial [e] cannot be excluded from the stem on phonological or morphological grounds. However, as seen below, initial [e] is only variably present in reduplication. Both the forms in the column on the right with initial [e], which show infixation, and the forms in the column on the left without initial [e], which act like typical consonant-initial roots, are acceptable forms.

(48)

- | | |
|--|----------------------|
| a. ku-bayi-ba / kw- <u>eba</u> -y-eba | to steal a little |
| b. ku-tfuka-tfuka / kw-e-tfuka-tfuka | to surprise a little |
| c. ku-lap ^h a-lap ^h a / kw-e-lap ^h a-lap ^h a | to heal a little |
| d. ku- <u>ɬuka</u> -ɬukanisa / kw-e- <u>ɬuka</u> -ɬukanisa | to divide a little |
| e. ku-lusa-lusa / kw-e-lusa-lusa | to herd a little |
| f. ku- <u>nɰula</u> -nɰula / kw-e- <u>nɰula</u> -nɰula | to pass by a little |

In fact, the variability of the vowel [e] is not limited to reduplication, but occurs throughout the verb paradigms. Again, the forms in the column on the right with initial [e], which pattern like other vowel-initial roots, and the forms in the column on the left without initial [e], which pattern just like other consonant-initial roots, are acceptable forms.

(49)

- | | |
|--|------------------|
| a. ku-b-a / kw-eb-a | to steal |
| b. ku-tfuk-a / kw-etfuk-a | to be surprised |
| c. tfuk-a / y-etfuk-a | insult! |
| d. ts ^{hi} y-a / y-ets ^{hi} y-a | trap! |
| e. ŋa-suts-a / ŋ-esuts ^h -a | I was full |
| f. ŋa-lap ^h -a / ŋ-elap ^h -a | I healed |
| g. ŋi-sab-ile / ŋ-esab-ile | I was afraid |
| h. ŋi-yam-ile / ŋ-eyam-ile | I leaned against |

There may be some social marking associated with the presence vs. absence of this vowel. The presence of the [e] is perceived as more "SiSwati" while the absence of the [e] is perceived as more "Zulu" (a closely related language). Thus, it can be concluded that "domain mismatches" described by Downing involving onsetless initial [e] may simply be a by-product of the fact that all onsetless, stem-initial vowels are excluded from the prosodic domain of the stem. That leaves only the cases with infixing reduplication with [e], which may be due to the special status of [e] vs. the other vowels, not to the special status of onsetless vowels in general.

7. Noun-Class Prefix

There are two noun class prefixes (class 3 and class 1) which provide evidence for a bisyllabic prosodic domain outside of the verbal domain. These prefixes both have the form [um-] (seen in (50)) unless the noun has the shape -CV-, in which case it is [umu-] (seen in (51)). This is another case of a length-based alternation. Given that onsetless vowels have a different status than vowels with onsets, as discussed above, it can be seen that when the onsetless vowel is excluded from the count, then the word must be at least two syllables long.

(50)

- | | | | |
|--------------------------|-------|------------|-------------|
| a. um-k ^h ono | arm | d. um-galu | marula tree |
| b. um-lilo | fire | e. um-fula | river |
| c. um-ntfwana | child | | |

(51)

- | | | | |
|-------------|-----------|--------------------------|----------|
| a. umu-no | finger | c. umu-k ^h wa | knife |
| b. umu-t'i | homestead | d. umu-ts ^h i | medicine |
| c. umu-ntfu | person | | |

The -CV- nouns can be compared with the plural forms in order to show that the nouns are indeed of the form -CV- and not of the form -uCV-.

(52)

- | | | | |
|------------|------------|--------------------------|-----------|
| a. imi-nwe | fingers | c. imi-k ^h wa | knife |
| b. imi-t'i | homesteads | d. imi-ts ^h i | medicines |

Excluding the initial onsetless vowel from consideration, this seems to be another case of the size of the affix depending on the size of the base— together, they must be at least bisyllabic.

8. Conclusion

In conclusion, a different type of prosodic structure has been described here. This type of structure, rather than being a rhythmic, strictly layered primitive which applies to all

syllables, is better considered as a product of two concepts, binarity and domains. The bisyllabic prosodic domain is not claimed to exist over all syllables throughout the language, but only where there is evidence such as length-based alternations or edge-effects. Furthermore, this bisyllabic prosodic domain need not be present for a syllable to be pronounced. Thus, this study of SiSwati prosodic structure provides new insight into the types of prosodic systems possible in natural language.

References

- BAGEMIHL, BRUCE. 1991. Syllable Structure in Bella Coola. *Linguistic Inquiry* 22:4. 589-646.
- BRADSHAW, MARY. 1996. Depressor Effects in SiSwati. Paper presented at the 27th ACAL.
- CHEN, SU-I and GLORIA MALAMBE. 1995. Palatalization in SiSwati. Paper presented at the 26th ACAL.
- COHN, ABIGAIL and JOHN J. MCCARTHY. 1994. Alignment and Parallelism in Indonesian Phonology. ms.
- COLE, JENNIFER and CHARLES W. KISSEBERTH. 1994. An Optimal Domains Theory of Harmony. University of Illinois Cognitive Science Technical Report.
- CONNELLY, M. 1984. Basotho Children's Acquisition of Noun Morphology. Unpublished Doctoral Dissertation, University of Essex, Colchester. Cited in Demuth (1996).
- CUTLER, ANNE. 1990. Exploiting Prosodic Probabilities in Speech Segmentation. in *Cognitive models of Speech Processing*. Gerry T. M. Altmann, ed. 105-121.
- and Dennis Norris. 1988. The Role of Strong Syllables in Segmentation for Lexical Access. *Journal of Experimental Psychology: Human Perception and Performance*. vol. 14. 113-121.
- DAVIS, STUART and W. VAN SUMMERS. 1989. Vowel Length and Closure Duration in Word-Medial VC Sequences. *Journal of the Acoustical Society of America* 85, supplement 1. S28.
- DEMUTH, KATHERINE. 1996. The Prosodic Structure of Early Words. in *Signal to Syntax*. James L. Morgan and Katherine Demuth, eds. p.171-184.
- DONNELLY, SIMON. 1996. Optimal Gaps: Parasitic Domain Structure in Phuthi. Paper presented at the 27th ACAL.
- DOWNING, LAURA. 1996. Correspondence Effects in SiSwati Reduplication. Paper presented at FLSM 7.
- 1995. On the Prosodic Misalignment of Onsetless Syllables. ms. University of Pennsylvania.
- (1994). SiSwati Verbal Reduplication and the Theory of Generalized Alignment. *NELS* 24.
- 1993. Unsyllabified Vowels in Aranda. *CLS* 29.
- ECHOLS, CATHARINE H. 1996. A Role for Stress in Early Speech Segmentation. in *Signal to Syntax*. James L. Morgan and Katherine Demuth, eds. 151-170.
- GERKEN, LOUANN. 1996. Phonological and Distributional Information in Syntax Acquisition. in *Signal to Syntax*. James L. Morgan and Katherine Demuth, eds. 411-425.
- HANKAMER, JORGE. 1989. Morphological Parsing and the Lexicon. in *Lexical Representation and Process*. William Marslen-Wilson, ed. The MIT Press: Cambridge, Massachusetts.
- HAYES, BRUCE. 1995. *Metrical Stress Theory*. The University of Chicago Press: Chicago.
- HSIAO, ELAINE. 1995. Evidence of Internal Domain Structure: Kinyarwanda Lexical Tone. paper presented at the Mid-Continental Workshop on Phonology.
- HOMER, MOLLY. 1995. Segment Sets Account for Opacity in Applecross Gaelic Nasal Harmony. Paper presented at the Mid-Continental Workshop on Phonology.
- ITO, JUNKO. 1990. Prosodic Minimality in Japanese. *CLS*.

- , YOSHIHISA KITAGAWA, and ARMIN MESTER. 1995. Prosodic Faithfulness and Correspondence: Evidence from a Japanese Argot. to appear in *Journal of East Asian Linguistics*.
- KISSEBERTH, CHARLES W. 1994. On Domains. in *Perspectives in Phonology*. Jennifer Cole and Charles Kisseberth, eds. Center for the Study of Language and Information.
- KIYOMI, SETSUKO and STUART DAVIS. 1992. Verb Reduplication in SiSwati. *African Languages and Cultures* 5,2: 113-124.
- LAUEFER, CHRISTIANE. 1992. Patterns of Voicing-Conditioned Vowel Duration in French and English. *Journal of Phonetics* 20. 411-440.
- LEBEN, WILLIAM. 1973. *Suprasegmental Phonology*. PhD Dissertation. MIT.
- LIBERMAN MARK and ALAN PRINCE. 1977. On Stress and Linguistic Rhythm. *Linguistic Inquiry* 8:2. 249-336.
- MARSLEN-WILSON, W. D. and A. WELSH. 1978. Processing Interactions and Lexical Access during Word Recognition in Continuous Speech. *Cognitive Psychology* 10. 29-63.
- MATTINGLY, IGNATIUS. 1981. Phonetic Representation and Speech Synthesis by Rule. in *The Cognitive Representation of Speech*. T. Myers, J. Laver, and J. Anderson, eds. 415-419.
- NESPOR, MARINE and IRENE VOGEL. 1986. *Prosodic Phonology*. Dordrecht: Foris.
- ODDEN, David. 1994. Domains and Levels of Representation in Tone. Paper presented at the First World Congress of African Linguistics.
- 1995. The Status of Onsetless Syllables in Kikerewe. in *Ohio State University Working Papers in Linguistics* 47. D. Dowty, R. Herman, E. Hume and P. Pappas, eds. 89-110.
- OHALA, JOHN J. 1992. The Segment: Primitive or Derived? in G.J. Docherty & D.R. Ladd, eds. *Papers in Laboratory Phonology II: Gesture, Segment, Prosody*. pp. 166-183.
- SELKIRK, ELISABETH O. 1986. On Derived Domains in Sentence Phonology. *Phonology Yearbook* 3. 371-405.
- 1984. *Phonology and Syntax: The Relation Between Sound and Structure*. Cambridge, Mass.: MIT Press.
- 1980. The Role of Prosodic Categories in English Word Stress. *Linguistic Inquiry* 8:2. 563-605.
- STOWELL, TIM. 1979. Stress Systems of the World Unite! MIT Working Papers in Linguistics, volume 1. Ken Safir, ed. 15-76.
- TALJAARD, P.C., J.N. KHUMALO, and S.E. BOSCH. 1991. *Handbook of SiSwati*. J. L. Van Schaik: Pretoria.
- TRUBETZKOY, N.S. 1969. *Principles of Phonology*. translated by Christiane A.M. Baltaxe. University of California Press: Berkely and Los Angeles.
- ZIERVOGEL, D. and E.J. MABUZA. 1976. *A Grammar of the Swati Language (siSwati)*. J. L. Van Schaik: Pretoria.